

CLAIMS

What is claimed is:

- 5 1. An arrhythmia discrimination method, comprising:
 sensing electrocardiogram signals at a subcutaneous non-intrathoracic
 location;
 receiving signals associated with a non-electrophysiological cardiac source;
 verifying that the electrocardiogram signals comprise a cardiac signal using
10 the non-electrophysiological signal;
 discriminating, using the electrocardiogram signals and non-electrophysiologic
 signals, between a normal sinus rhythm and a cardiac arrhythmia; and
 withholding delivery of subcutaneous non-intrathoracic cardiac stimulation
 therapy if the sensed signal is not the cardiac signal.
- 15 2. The method of claim 1, wherein discriminating between normal sinus
 rhythm and the arrhythmia comprises:
 detecting the arrhythmia using the electrocardiogram signals; and
 verifying presence of the arrhythmia using the non-electrophysiologic signals.
- 20 3. The method of claim 1, wherein discriminating between normal sinus
 rhythm and the arrhythmia comprises:
 detecting the arrhythmia using the electrocardiogram signals;
 determining temporal relationships between the electrocardiogram signals and
25 non-electrophysiologic signals received while detecting the arrhythmia; and
 verifying presence of the arrhythmia based on the temporal relationships
 between the electrocardiogram signals and non-electrophysiologic signals.

4. The method of claim 1, wherein discriminating between normal sinus rhythm and the arrhythmia comprises:

5 initiating a detection window in response to receiving each electrocardiogram signal of a succession of the electrocardiogram signals; and

determining whether each non-electrophysiologic signal of a succession of the non-electrophysiologic signals is received at a time falling within the detection window.

10 5. The method of claim 1, wherein discriminating between normal sinus rhythm and the arrhythmia comprises:

computing a first rate based on successive electrocardiogram signals;

computing a second rate based on successive non-electrophysiologic signals;

and

15 discriminating between normal sinus rhythm and the arrhythmia using the first and second rates.

6. The method of claim 1, wherein discriminating between normal sinus rhythm and the arrhythmia comprises:

20 computing a first rate based on successive electrocardiogram signals;

computing a second rate based on successive non-electrophysiologic signals;

comparing the first rate with a first arrhythmia threshold;

comparing the second rate with a second arrhythmia threshold; and

25 determining presence of the arrhythmia in response to both the first and second rates exceeding the first and second arrhythmia thresholds, respectively.

7. The method of claim 1, wherein discriminating between normal sinus rhythm and the arrhythmia comprises:

computing a first rate based on successive electrocardiogram signals;
computing a second rate based on successive non-electrophysiologic signals;
5 comparing the first rate with a first arrhythmia threshold;
comparing the second rate with a second arrhythmia threshold; and
determining absence of the arrhythmia in response to the first rate exceeding
the first arrhythmia threshold and the second rate failing to exceed the second
arrhythmia threshold.

10 8. The method of claim 1, wherein discriminating between normal sinus rhythm and the arrhythmia comprises:

determining presence of the arrhythmia using a morphology of the
electrocardiogram signals; and

15 verifying presence of the arrhythmia using the non-electrophysiologic signals.

9. The method of claim 1, wherein the non-electrophysiologic signals
comprise heart sound signals.

20 10. The method of claim 1, wherein the non-electrophysiologic signals
comprise subsonic acoustic signals indicative of cardiac activity.

11. The method of claim 1, wherein the non-electrophysiologic signals
comprise pulse pressure signals.

25 12. The method of claim 1, wherein the non-electrophysiologic signals
comprise impedance signals indicative of cardiac activity.

13. The method of claim 1, wherein the non-electrophysiologic signals comprise pulse oximetry signals.

5 14. The method of claim 1, further comprising declaring an arrhythmic episode in response to detecting the arrhythmia using the electrocardiogram signals and detecting the arrhythmia using the non-electrophysiologic signals.

10 15. The method of claim 1, further comprising enabling defibrillation therapy delivery in response to detecting the arrhythmia using the electrocardiogram signals and detecting the arrhythmia using the non-electrophysiologic signals.

15 16. The method of claim 1, further comprising inhibiting defibrillation therapy delivery in response to detecting the arrhythmia using the electrocardiogram signals but not detecting the arrhythmia using the non-electrophysiologic signals.

17. An arrhythmia discrimination method, comprising:
sensing an electrocardiogram signal at a subcutaneous non-intrathoracic location;
20 receiving a signal associated with a non-electrophysiological cardiac source;
verifying that the sensed electrocardiogram signal comprises a cardiac signal using the non-electrophysiological signal;
detecting a cardiac arrhythmia using one of the sensed electrocardiogram signal and the verified cardiac signal; and
25 withholding treatment of the cardiac arrhythmia if the sensed signal is not the cardiac signal.

18. The method of claim 17, further comprising:
defining a detection window with a start time associated with an inflection
point of the electrocardiogram signal; and
evaluating the received non-electrophysiological signal within the detection
5 window.

19. The method of claim 18, wherein the start time of the detection window
is associated with a maxima or a minima of the electrocardiogram signal.

10 20. The method of claim 17, further comprising:
computing a first heart-rate based on intervals between successive
electrocardiogram signals; and
computing a second heart-rate based on intervals between successive non-
electrophysiological cardiac signals;
15 wherein confirming presence of the cardiac arrhythmia comprises comparing
the first heart-rate to the second heart-rate.

21. The method of claim 17, wherein confirming presence of the cardiac
arrhythmia comprises performing a correlation between the electrocardiogram signal
20 and the non-electrophysiological cardiac signal.

22. The method of claim 17, wherein the non-electrophysiological cardiac
signal comprises acoustic emission information.

25 23. The method of claim 22, wherein the acoustic emission information
comprises a temporal location of a peak heart-sound.

24. The method of claim 17, wherein the non-electrophysiological cardiac signal comprises cardiac acceleration information.

25. The method of claim 17, wherein the non-electrophysiological cardiac
5 signal comprises pulse pressure information.

26. The method of claim 17, wherein the non-electrophysiological cardiac signal comprises blood-flow information.

10 27. The method of claim 17, wherein the non-electrophysiological cardiac signal comprises heart rate information.

28. The method of claim 17, wherein the non-electrophysiological cardiac
15 signal comprises pulse oximetry information.

29. The method of claim 17, wherein detecting presence or non-presence of the cardiac arrhythmia comprises performing a rate based analysis of the electrocardiogram signal.

20 30. The method of claim 17, wherein detecting presence or non-presence of the cardiac arrhythmia comprises performing a morphology based analysis of the electrocardiogram signal.

31. The method of claim 17, further comprising delivering a cardiac therapy
25 to treat the cardiac arrhythmia.

32. An implantable cardiac device, comprising:

an implantable housing;

5 an electrode arrangement configured for subcutaneous non-intrathoracic placement;

detection circuitry provided in the housing and coupled to the electrode arrangement, the detection circuitry configured to detect electrocardiogram signals;

a sensor configured to sense signals associated with a non-electrophysiological cardiac source;

10 energy delivery circuitry coupled to the electrode arrangement; and

a processor provided in the housing and coupled to the detection circuitry, sensor, and energy delivery circuitry, the processor using the non-

15 electrophysiological signals to verify that the detected electrocardiogram signals comprise a cardiac signal, the processor withholding treatment of the cardiac arrhythmia if the detected electrocardiogram signals do not comprise the cardiac signal.

33. The device of claim 32, wherein the energy delivery circuitry comprises defibrillation therapy circuitry.

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34. The device of claim 32, wherein the energy delivery circuitry comprises pacing therapy circuitry.

35. The device of claim 32, wherein the sensor is provided in or on the
25 housing.

36. The device of claim 32, wherein the sensor is provided in or on a lead coupled to the housing.

5 37. The device of claim 32, wherein the sensor comprises an accelerometer.

38. The device of claim 32, wherein the sensor comprises a microphone.

10 39. The device of claim 32, wherein the sensor comprises an acoustic transducer.

40. The device of claim 32, wherein the sensor comprises a blood-flow transducer.

15 41. The device of claim 32, wherein the sensor comprises a pulse oximeter.

42. The device of claim 32, wherein the sensor comprises photoplethysmography circuitry.

43. An implantable device, comprising:
means for sensing an electrocardiogram signal at a subcutaneous non-intrathoracic location;

5 means for receiving a signal associated with a non-electrophysiological cardiac source;

means for verifying that the sensed electrocardiogram signal comprises a cardiac signal using the non-electrophysiological signal;

10 means for detecting a cardiac arrhythmia using one of the sensed electrocardiogram signal and the verified cardiac signal; and

means for withholding treatment of the cardiac arrhythmia if the sensed signal is not the cardiac signal.

44. The device of claim 43, wherein the discriminating means comprises:
15 means for detecting the arrhythmia using the electrocardiogram signals; and
means for verifying presence of the arrhythmia using the non-electrophysiologic signals.

45. The device of claim 43, comprising means for implantably treating the
20 cardiac arrhythmia.